

CLAIMS:

1. A PWM waveform-generator apparatus in which a series of pre-determined pulse widths are modulated in accordance with a pre-determined protocol, comprising:
means for generating a plurality of on/off timing-based interrupts;
means for generating a force on/off action-based interrupt having a programmable
5 control;
means for generating a force on/off action-based interrupt having an external control; and,
means for interpreting said generated plurality of timing-based interrupts and said
at least one action-based interrupt such that the series of pulse widths of the PWM
10 waveform generator are modulated in accordance with said protocol.
2. The PWM waveform-generator apparatus of claim 1, wherein:
the means for generating a plurality of on/off timing-based interrupts is a
programmable on-off-control part;
15 the means for generating a force on/off action-based interrupt having a programmable control is the programmable on-off control part;
the means for generating a force on/off action-based interrupt having an external control is selection from the group consisting of an external force_on action and an external force_off action; and,
20 the interpreting means is a multiple-event-interrupts part comprising a software interrupt routine for handling each timing-based and action-based interrupt.
3. The PWM waveform generator apparatus of claim 2, wherein said programmable on-off-control part comprises:
25 an on-time control comprising a first timer and a first comparator; and
an off-time control comprising a second timer and second comparator,
wherein the on-time control is enabled for a first period and the off-time control is disabled when the PWM is high and the off-time control is enabled for a second period and the on-

time control is disabled when the PWM is low, such that the first and second control are alternately enabled and disabled.

4. The PWM waveform generator apparatus of claim 3, wherein:

5 for on/off timing said protocol comprises at least one of:

- a programmable on-pulse width Min_on parameter control,
- a programmable on-period Max_on parameter control,
- a programmable off-pulse width Min_off parameter control,
- a programmable off-period Max_off parameter control,

10 at least one event control selected from a programmable event control for triggering a force-off event and an external event control for triggering a force-off event,

at least one event control selected from a programmable event control for triggering a force-on event and an external event control for triggering a force-on event,

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wherein at least one of a force-on event and a force-off event can be triggered in an on-period and in an off-period.

5. The PWM waveform-generator apparatus of claim 4, wherein:

20 the first timer and second timer respectively comprises a first and third register;

the first and second comparator respectively comprises a second and fourth register;

wherein, when the on-time control is enabled,

a. the second register has been pre-loaded by the on-time control with a compare value equal to a pre-determined minimum on-width (minimum on-time Min_on) of the PWM, the first register has been pre-loaded with a predetermined maximum on-width (maximum on-time Max_on) of the PWM such that there is no delay time for loading said first and second register,

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b. a first interrupt is triggered by the first comparator when the second register equals the compare value and a second interrupt is triggered by the first timer when the first register equals a pre-determined first period, at least one action-based interrupt can be triggered at least once during one period of the PWM according to the pre-determined protocol, thereby turning off the PWM by the on-time control when at least one of the

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second interrupt and the at least one action-based interrupt is triggered and the first interrupt is triggered, and

when the off-time control is enabled

5 c. the fourth register has been pre-loaded with a compare value equal to a pre-determined minimum off-width (minimum off-time Min_off) of the PWM, the third register has been pre-loaded with a predetermined maximum off-width (maximum off-time Max_off) of the PWM such that there is no delay time for loading said third and fourth register,

10 d. a third interrupt is triggered by the second comparator when the fourth register equals the compare value and a fourth interrupt is triggered by the second timer when the third register equals the pre-determined second period, at least one action-based interrupt can be triggered at least once during one period of the PWM according to the pre-determined protocol, thereby turning on the PWM by the off-time control when at least one of the fourth interrupt and the at least one action-based interrupt is triggered and the third
15 interrupt is triggered.

6. A microprocessor for performing the programmable on-off control and the software interrupt routines as claimed in claim 2.

20 7. A method of programmable control of a PWM generator in which a signal is modulated as a series of on/off pulses each having a width and a period in accordance with a pre-determined protocol, comprising the steps of:

providing a pre-determined protocol for a series of pulse widths and periods;

25 generating a plurality of on/off timing-based interrupts in accordance with the provided protocol;

generating at least one force on/off action-based interrupt in accordance with the provided protocol;

interpreting said generated plurality of timing-based interrupts and said at least one action-based interrupt in accordance with said protocol.

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8. The method of claim 7, wherein:

the step of generating a plurality of on/off interrupts further comprises the steps of:

- a. providing a programmable-on-off-control part, and
- b. controlling the generation of said plurality of on/off timing-based interrupts

5 by the provided programmable on-off control part;

the step of generating at least one force on/off action-based interrupt further comprises at least one of the steps of:

c. generating the at least one force on/off action-based interrupt by the provided programmable on-off control part;

10 d. performing the substeps of:

- 1. providing an external control for the generation of the at least one force on/off action-based interrupt; and
- 2. generating the at least one force on/off action-based interrupt by the provided external control.

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9. The method of claim 8, wherein the interpreting step further comprises the steps of:

- e. providing a multiple event-interrupts part; and
- f. controlling the interpretation of at least one action-based interrupt by the provided multiple event-interrupts part.